

## CLAIM

1. A gallium nitride (GaN) based light-emitting device (LED), comprising:
  - a light-emitting body comprising a GaN-based material capable of emitting a light;
  - 5 a light extraction layer comprising:
    - a current spreading layer disposed over said light-emitting body; and
    - a micro-structure layer disposed over said current spreading layer, wherein the micro-structure is a TiN layer having a nano-net structure.
- 10 2. The LED according to claim 1, wherein said light-emitting body comprises an n-type GaN-based layer, a semiconductor active layer and a p-type GaN-based layer and said semiconductor active layer is disposed over said n-type GaN-based layer and said p-GaN-based layer is disposed over said active layer.
3. The LED according to claim 1, wherein said light-emitting body has a p-type electrode and an n-type electrode and said p-type electrode is disposed over said  
15 micro-structure layer.
4. The LED according to claim 3, wherein said p-type electrode is disposed beside said micro-structure layer and said current spreading layer.
5. The LED according to claim 1, wherein said current spreading layer is a transparent and conductive layer and selected from a group consisting of a  
20 Ni/Au double layer structure, Ni, Pt, Pd, Rh, Ru, Os, Ir, Zn, In, Sn, Mg and an oxide thereof.
6. The LED according to claim 1, wherein said TiN nano-net is formed by nitridating a Ti layer.
7. A gallium nitride (GaN) based light-emitting device (LED), comprising:

a light-emitting body comprising a GaN-based material capable of emitting a light; and

a light extraction layer comprising:

a current spreading layer disposed over said light-emitting body; and

5 a micro-structure layer disposed over said current spreading layer and being a Pt layer having metal clusters.

8. The LED according to claim 7, wherein said light-emitting body comprises an n-type GaN-based layer, a semiconductor active layer and a p-type GaN-based layer and said semiconductor active layer is disposed over said n-type  
10 GaN-based layer and said p-GaN-based layer is disposed over said active layer.

9. The LED according to claims 7 and 8, wherein said light-emitting body has a p-type electrode and an n-type electrode and said p-type electrode is disposed over said micro-structure layer.

10. The LED according to claim 9, wherein said p-type electrode is disposed  
15 beside said micro-structure layer and said current spreading layer.

11. The LED according to claim 6, wherein said current spreading layer is a transparent and conductive layer and selected from a group consisting of a Ni/Au double layer structure, Ni, Pt, Pd, Rh, Ru, Os, Ir, Zn, In, Sn, Mg and an oxide thereof.

20 12. The LED according to claim 7, wherein said Pt layer having metal clusters is formed by annealing a Pt layer.

13. A method of manufacturing a gallium nitride (GaN) based light-emitting device (LED), comprising the steps of:

preparing a substrate;

forming an n-type GaN-based layer over said substrate;  
forming a semiconductor active layer over said n-type GaN-based layer;  
forming a p-type GaN-based layer over said semiconductor active layer;  
forming a current spreading layer over said p-GaN-based layer; and  
5 forming a micro-net layer over said current spreading layer.

14. The method according to claim 13, further comprising a step of forming a p-type electrode and an n-type electrode over said LED after said step of forming said micro-net layer and wherein said p-type electrode is formed over said micro-net structure or beside said micro-structure layer and said current  
10 spreading layer.

15. The method according to claim 13, wherein said current spreading layer is a transparent and conductive layer and selected from a group consisting of a Ni/Au double layer structure, Ni, Pt, Pd, Rh, Ru, Os, Ir, Zn, In, Sn, Mg and an oxide thereof.

15 16. The method according to claim 13, wherein said step of forming a micro-structure layer further comprises a step of forming a Ti layer over said p-type GaN-based layer and then nitridating said Ti layer.

17. The method according to claim 13, wherein said step of forming a micro-structure layer further comprises a step of forming a Pt layer over said  
20 p-type GaN-based layer and then annealing said Pt layer.

18. A gallium nitride (GaN) based light-emitting device (LED), comprising:

a light-emitting body comprising a GaN-based material and capable of emitting a light;

a GaN-based p<sup>+</sup>/n<sup>+</sup> tunneling junction layer disposed over said

light-emitting body;

a light extraction layer disposed over said p+/n+ tunneling junction layer, the light extraction layer being a TiN layer having a nano-net structure or a Pt layer having metal clusters.

5 19. The LED according to claim 18, wherein said light-emitting body comprises an n-type GaN-based layer, a semiconductor active layer and a p-type GaN-based layer, said semiconductor active layer is disposed over said n-type GaN-based layer and said p-GaN-based layer is disposed over said active layer.

10 20. The LED according to claim 18, wherein said light-emitting body has a p-type electrode and an n-type electrode and said p-type electrode is disposed over a micro-structure layer.

21. The LED according to claim 18, wherein said TiN having said nano-net structure is formed by nitridating a Ti layer and said Pt having said metal clusters is formed by annealing a Pt layer.

15 22. The LED according to claim 18, wherein said light extraction layer further comprises a current spreading layer and said current spreading layer is a transparent and conductive layer and selected from a group consisting of a Ni/Au double layer structure, Ni, Pt, Pd, Rh, Ru, Os, Ir, Zn, In, Sn, Mg and an oxide thereof.

20 23. A gallium nitride (GaN) based light-emitting device (LED), comprising:  
a conductive metal substrate;  
a conductive metal reflector disposed over said substrate;  
a p-type GaN-based layer disposed over said metal reflector;  
a semiconductor active layer disposed over said p-type GaN-based layer;

an n-type GaN-based layer disposed over said semiconductor active layer; and

a micro-structure layer disposed over said n-type GaN-based layer, the micro-structure layer being a TiN layer having a nano-net structure or a Pt layer having metal clusters.

24. The LED according to claim 23, wherein a p-type metal is disposed below said conductive metal substrate and an n-type substrate is disposed over said micro-structure layer.

25. The LED according to claim 23, wherein said TiN having said nano-net structure is formed by nitridating a Ti layer and said Pt having said metal clusters is formed by annealing a Pt layer.